The aim of this insert is to provide information needed for successful paving and is intended for small paving contacts and DIY home builders.

**Section 1**

The purpose of this insert is to detail the correct procedures and techniques required to achieve a high quality concrete paving installation, via site management and laying. Whilst this insert covers the installation of paving blocks and the construction of edge restraints, the reader is reminded that these are only part of the total pavement. To achieve a durable and economic pavement, the following aspects must be considered.

a) Design Loads

Estimation of traffic type and frequency and the use of vehicles is to be determined by a professional engineer/competent person.

b) Earthworks

Assessment of insitu material strength and design layer works to support design traffic is to be determined by a professional engineer/competent person.

c) Drainage

Determination of the correct drainage design for both underground water and surface water flows to avoid premature failures of the earthworks. Refer: Professional engineer/competent person.

d) Edge Restraints

Provision of resistance to lateral movement Refer: Section 4 in this insert.

e) Block Paving

Determine the thickness of block and laying pattern Refer to sections 5 to 18 in this insert.

**Section 2**

Before paving work commences, an inspection of the site should be carried out by the paviour. Items to be checked should include:

- earthworks surface tolerances

- sufficient slopes for drainage (minimum of 2%).

- correct levels to allow the finished block paving to tie into buildings, manholes, drainage outlets etc.

- edge restraints – if done by others
Whilst the above items are not the responsibility of the paviour, the paving should not be laid if other works are not prepared adequately. It is recommended that the paviour request a certificate or written instruction from his client stating that the other works are complete and ready to receive the block paving. Any problems should be reported to the client who must arrange for the defective works to be rectified. The standard specification for the construction of pavements is contained in the SABS 1200 series with SABS 1200MJ covering concrete block paving. The paviour must also examine and allow for the following:

- contract drawings and specifications.
- setting out requirements for kerbs and edge restraints
- details and locations of manholes/catchpits.
- truck access for delivery of materials.
- material storage areas
- any restrictions to working areas

[figure 1]
Construction Planning Section 3

Economical construction of segmented paving requires co-ordination of the main activities of materials handling, installation of edge restraints and laying, compacting and sanding of blocks to ensure all operations are carried out in an orderly and efficient manner. Refer to figure 2 Cost effectiveness by means of job planning involves an overall assessment of the extent and type of work involved, the requirements for labour, materials and equipment, and time or other constraints.

Attention should be given to:

1. examining the drawings, for position of kerbs, manholes, catch pits and other penetrations or obstructions in order to minimise cutting of blocks.

2. the installation of edge restraints and kerbing.

3. planning the starting point for paving, subsequent development of the laying face and the use of string lines to control regularity of laying.

4. deciding on the location and phasing of placing, compacting and sanding teams to facilitate orderly progress of the paving; positioning of bedding and joint-filling sand stockpiles; co-ordination of paving block deliveries to minimise travel distances and double handling; selection of equipment to be used, particularly suitable trolleys or buggies etc. to facilitate transport of paving blocks from delivery points to the laying face.

5. processing of one days production must include total process to complete an area, from laying to compacting and sanding.
Edge Restraints Construction Section 4

The selection of different types of edge restraints depends on the type of service, the intended traffic load, the required performance life, aesthetic appeal, drainage requirements and cost. Refer to a professional engineer for details on edge restraints. Edge restraints must be positioned before block laying begins so that they can be used for reference levels and prevent the migration of blocks. Refer to figure 3 Edge restraints are useful as a screeding guide as the screed board can be cut to the required depth below the top of the edge restraint.

Edge restraints should be positioned on the subbase level and it is important that these are securely supported with an adequate concrete backing before block laying commences.

Laying of Building Sand Section 5

Ensure that the sand has been protected from either excessive drying out or wetting to ensure a uniform moisture content. Refer to figure 4 Varying moisture content leads to irregular compaction of the blocks into the sand. Sand which is too wet will not screed properly and be difficult to compact and sand which is too dry will not compact satisfactorily. For correct grading of bedding sand refer to Table 1.

<table>
<thead>
<tr>
<th>Sieve size, mm</th>
<th>% passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.700</td>
<td>100</td>
</tr>
<tr>
<td>4.750</td>
<td>95 - 100</td>
</tr>
<tr>
<td>2.360</td>
<td>80 - 100</td>
</tr>
<tr>
<td>1.180</td>
<td>50 - 85</td>
</tr>
<tr>
<td>0.600</td>
<td>25 - 60</td>
</tr>
<tr>
<td>0.300</td>
<td>10 - 30</td>
</tr>
<tr>
<td>0.150</td>
<td>5 - 15</td>
</tr>
<tr>
<td>0.075</td>
<td>0 - 10</td>
</tr>
</tbody>
</table>

[ table 1 : grading sand ]
Adequate compaction of the bedding sand under the blocks can be achieved at moisture contents typically lying within the range from 4 to 8%, with 6% representing a satisfactory target value. For sands complying with the grading limits, the effects of water content appear to have little influence on the behaviour of the pavement under traffic. However, where the bedding sand contains a significant proportion of clay, greater than about 10%, the infiltration of water into the bedding sand has been found to produce substantial increases in deformation accompanied by pumping. For this reason the use of sands containing active plastic fines should be avoided in the bedding layer.

Such sands are nevertheless suitable for use as jointing sands both in respect of their mechanical properties and as a means of inhibiting the ingress of water into the joints.

The use of plastic sheeting below the bedding sand is **NOT** recommended since it breaks the bond between the bedding sand layer and the subgrade or subbase layer and may induce horizontal creep of the block surface. It may also result in a reservoir of water collecting in the bedding sand layer. This water, if it evaporates through the blocks, can cause efflorescence.
Screeding the bedding sand Section 6

Distribute the bedding sand in sections, a few metres at a time, using the length of the screeding rails as a guide. Refer to figure 5 Lay screed rails roughly two metres apart on the prepared surface. The height of the screeded rails should match the uncompacted thickness of the screeded bedding sand to produce the desired surcharge. The thickness of the bedding sand layer should be 20 - 35mm after compaction. Do not permit workmen to walk on the screeded sand since this results in uneven compaction and an uneven block surface. If pockets or depressions appear behind the screed rail, fill them with loose sand and rescreen the area. To ensure an even uncompacted surface, make two or three passes with the screeding board. Avoid a sawing action when screeding as this results in an uneven surface area. Refer to figure 5b When screeding, adjust the bedding sand level up to edge restraints, kerbs, drainage structures or existing paved surfaces so that the paving, after compaction, will stand proud of the edging by 5-10 mm to allow for subsequent settlement.

Squaring up the area to be paved Section 7

It is important to commence work from one point only to ensure a uniform pattern of laying. Determine the line of paving to suit conditions. Align the pattern with the direction of the roadway or parallel to a wall or edge restraint. Since the kerb-line itself may not be perfectly true use two string-lines at right angles and check the accuracy of the alignment regularly.
Laying of the concrete blocks Section 8

Start laying the blocks in a right angle corner and work outwards in both directions. Establish a diagonal laying face to achieve optimum productivity. Refer to figure 8 If applicable, work uphill to prevent the effect of gravity and movement of the paving crew opening up joints between the blocks already laid. Refer to figure 10

Paving blocks supplied by Cem Brick must be laid tightly against each other as we have designed nibs to create the necessary space for the filling of jointing sand see figure 9.

Adjusting the pattern and lining up the blocks Section 9

Use a string-line to check the alignment for squareness once a specific area has been completed. Make any adjustments by using a lever to move sections of blocks. This should be carried out regularly to avoid the difficulty of adjusting large paved areas. The process must be undertaken prior to compaction and the spreading of jointing sand, as it will be difficult to move blocks after joint filling. See figure 11
Block cutting Section 10

Block cutting for precise infilling of space next to knibs and edge constraints, involves placing a full block next to the restraint on both ends then using a chalk line to mark the laid paving blocks to be cut. Fill in all void in cutting area with all good quality half bricks or three quarter bricks. After all voids are fitted tightly into place mark the area with a chalk line then cut with an angle grinder, allow a 2mm space for full header coarse block to fit in.

Header coarse to be laid in tight against paving blocks and gap between header coarse and restraint, filled in with sand, should gap be in excess of 3mm and smaller than 6mm. A proper slurry mix of 1 part cement to 2 parts sand is to be used to fill in the gap, the gap is to be properly corked and the fill should extend down to the sub base.

Vibrating blocks into place Section 11

Once the blocks have been placed, the edge cutting completed and prior to spreading the jointing sand the paved area has been swept clean of any sand small rocks etc. Insure that the base plate of your compacter is fitted with a rubber mat then blocks must be compacted into position by at least two passes of the plate compactor. This action will bed the blocks into the bedding sand. Check and remove blocks that have settled incorrectly i.e. either too high or too low and adjust level by removing or filling with bedding sand. Individual blocks, which are damaged, must be removed and replaced.
Sweeping in the jointing sand Section 12

Once a specified area has been paved, checked for line and level and the compaction completed, check and replace any damaged blocks. When complete, dry jointing sand should be swept into the joints between the blocks. Refer to figure 17. Do not use bedding sand as a substitute for jointing sand as this is often too coarse. The jointing sand should pass a 1,18mm sieve and contain 10-50% material passing the 0,075mm sieve. Do NOT hose the jointing sand into the joints with water as wet sand will bridge between the units and resist compaction and filling. This results in an unsightly and uneven paved surface. The sand bridges collapse once they dry out, leaving open gaps between the blocks leading to ingress of water and movement under traffic. Vibrating the jointing sand into the joints is carried out by two or three passes of the plate compactor. This creates the semi-rigid, interlocked surface. This process, which also achieves additional compaction of the individual blocks, should alternate with sweeping the jointing sand until the joints are completely filled. Jointing sand must not include cementitious materials, which would turn this flexible form of pavement into a rigid surface. If construction work is still in progress, excess jointing sand can be left in place after completion and swept off at a later stage. This helps to ensure complete filling of the joints during the period when the blocks are first trafficked. Thereafter excess sand should be removed from the paved area.

Vibrating the jointing sand into the joints Section 13

Vibrating the jointing sand into the joints is carried out by two or three passes of the plate compactor. This creates the semi-rigid, interlocked surface. This process, which also achieves additional compaction of the individual blocks, should alternate with sweeping the jointing sand until the joints are completely filled. Jointing sand must not include cementitious materials, which would turn this flexible form of pavement into a rigid surface. If construction work is still in progress, excess jointing sand can be left in place after completion and swept off at a later stage. This helps to ensure complete filling of the joints during the period when the blocks are first trafficked. Thereafter excess sand should be removed from the paved area.
Check list

☐ Select blocks of appropriate shape, thickness, quality and colour for the surface pattern required.
☐ Engineer to accept earthworks as ready for paving – levels and compaction
☐ Select appropriate edge restraints and install to correct line and level.
☐ Place bedding sand on site. Ensure sand has correct moisture content.
☐ Lay screeding rails on subbase layer.
☐ Tap a block into the loose bedding sand and measure the amount of surcharge. The thickness of the bedding
sand after compaction should be 20mm to 35mm.
☐ Spread bedding sand between screeding rails.
☐ Level sand with two or three passes with screeding board.
☐ Fill pockets or depressions in surface with loose sand and rescreen the area.
☐ Adjust the bedding sand level up to edge restraints when screening.
☐ Remove screed rail and fill recesses with loose sand.
☐ Ensure paving stands proud of fixtures to allow for bedding sand settlement.
☐ Commence laying from one starting point only - the lowest point.
☐ Use string lines to constantly check alignment.
☐ Square up the immediate area to be paved.
☐ Start laying the blocks in a right angle corner and work outwards.
☐ Establish a diagonal laying face.
☐ Allow a space of about 3mm between adjacent blocks.
☐ Make any adjustments to line and joint width by using a lever to move sections of blocks.
☐ Measure and cut blocks for edge spaces. Orientate blocks at the edge or use the double cut method to eliminate
the small edge space.
☐ Sweep the paved area clean.
☐ Compact paving blocks with at least two passes of a plate compactor ensure that the rubber mat is fitted on to the plate.
☐ Check and adjust for highs and lows.
☐ Sweep dry jointing sand into the joints between the blocks.
☐ Use a compactor to vibrate jointing sand into the joints.
☐ Top up joints with sand and recompact.
☐ Fill edge spaces of less than 25% of a full block, with a high-strength concrete. Only fill these spaces once
vibrating has been completed.
☐ Fit temporary restraints at the end of paving if it cannot be completed in one day. Finish paving at an angle.
☐ Use plastic sheeting to cover the temporary restraint and exposed bedding sand in the event of overnight rain.
☐ Restart work on the previously established angle to the kerb-line.
Maintenance Section 14

a) Resanding

Frequently, jointing sand is lost in the early stages of the pavement life due to wind, rain or traffic. It is advisable that pavements are inspected after three to four months and where unnecessary, resanded and at regular intervals thereafter. Lack of jointing sand causes blocks to tilt under traffic and spall.

b) Weed growth

Occasionally, grass and weeds grow in the joints between blocks. This generally is a result of windblown seeds and is not prevented by the use of a plastic sheet under the paving. Herbicides can be mixed into the bedding sand and jointing sand or sprayed onto the finished paving. This, however, will leach out in time and will require respraying on a frequent basis. Weeds and grass will not grow in highly trafficked areas.

c) Settlement/subsidence

Settlement of the paved surface is generally a result of inadequate earthworks, or overloading. Concrete block paving is particularly advantageous in this regard, since a section of the paving can be lifted, the earthworks repaired and the pavers relaid, resulting in an unscarred surface.

d) Reinstatement of trenches after opening

One of the major advantages of using concrete block paving as a surfacing material is that access to underground services for maintenance purposes can easily be obtained, and reinstatement carried out in such a manner that the repair is invisible and does not result in an unsightly scar, as would be the case with other paving materials. Details of the procedure to be obtained from engineer or competent person.

e) Efflorescence

There is a chance that after a few weeks or months pass, a white haze may appear on the surface of the pavers. This so-called white haze is known as efflorescence and is a natural phenomenon. It may appear randomly or in certain areas, and will be more pronounced on dark coloured pavers. The white haze may give the impression that the colour of the pavers is fading. When wet, the white disappears and the colour of the pavers is enhanced. When dry, the white haze reappears.

Efflorescence is a white deposit, which is apparent either as white particles or as an overall lightening in colour. The latter effect is sometimes mistakenly interpreted as the colour fading or being washed out. Efflorescence is usually a transient phenomenon and can be expected to disappear with time. The major factor influencing its duration is the environment to which the concrete is exposed. Where the concrete is fully exposed to the weather, rainwater (which is slightly acidic) dissolves the deposit and the efflorescence typically disappears in about a year. In more sheltered locations, removal by natural means may take considerably longer.

It is strongly recommended that efflorescence is allowed to disappear naturally to avoid damage by an acid wash. Cem Brick does not recommend an acid wash and any consequences thereof will be for owners loss.

Rain usually washes the efflorescence away in about 1 to 2 years. If you do not want to wait that long, you can wash with diluted hydrochloric acid (1 part hydrochloric acid, 20 parts water) as a quick remedy this is not recommended by Cembrick and any consequence will be for the owners loss. This has the additional advantage of washing out the lime in the upper layers of the concrete. However, the stone surface becomes rougher and the shade changes slightly. The acid should be washed off thoroughly with water afterwards.

Chemistry of efflorescence

All concrete products contain cement, which produces lime or watersoluble calcium oxide. Lime can also be in the bedding sand, aggregate based materials or soil. Although concrete products are solid, strong and very dense, they contain millions of microscopic capillaries that run from the interior to the surface. Moisture from rain, sprinkler systems, underground sources, poor drainage or dew enters these microscopic capillaries and forms
calcium oxide. Inside the concrete product this reacts with the water in the capillaries and forms calcium hydroxide. This rises to the surface, reacts with the carbon dioxide in the air and forms a white haze of calcium carbonate. When the moisture on the surface of the concrete product evaporates, the white haze of efflorescence becomes visible. If immediate removal is required this can be achieved by washing with diluted acid. Generally a 5% solution of hydrochloric acid or a proprietary acid-based concrete cleaner is used.

Before the acid solution is applied, the surface should be dampened with water to prevent the initial suction. This prevents the acid solution from being sucked into the concrete before it has a chance to react with the surface deposit. The acid solution is applied by brush or spray and a typical application rate is one litre of acid solution to ±10 square metres. Following application of acid solution, the surface of the concrete is washed and allowed to dry out and is then inspected. Often one wash with acid solution is sufficient, but in more stubborn cases the treatment is repeated as necessary until the efflorescence disappears. Finally, it is advisable to give the concrete a final wash with water. When carrying out acid washing, always test the effect on an inconspicuous area before doing the main area. Efflorescence is unlikely to recur following its removal with an acid solution.

f) Oil Stains

Paving is often stained by oil, diesel or other liquids. The best method of removing these stains is to scrub with a hard bristle brush and a strong detergent and to wash off with water. Where oil stains are to be expected, such as on a garage forecourt, it is recommended that, during construction, a number of coloured pavers are used in a random fashion to create a mottled effect. This will help reduce the visibility of oil stains if they occur. Alternatively a darker paver should be specified.

g) Sealers

There are a number of proprietary brand sealers on the market (silicone, silanes and siloxanes). These sealers have the advantage that they bring out the colour of the pavers and reduce the chances of oil stains. They also reduce the permeability of the sand joints. If required, sealers should be applied when the paving is new or has been thoroughly cleaned. However in most cases, the cost of sealers will not warrant the application. Also the surface is subjected to abrasive action, which will remove the surface sealers, and this will become a regular maintenance item.